

SPATIO-TEMPORAL ANALYSIS OF INDUSTRIAL CLUSTERS - A CASE OF MADHYA PRADESH

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ABSTRACT: The purpose of this study is to provide spatial analysis of industrial clusters by identifying them and, then, to discuss the spatio-temporal evolution and regional structure of industrial clusters in Madhya Pradesh.

INTRODUCTION

Spatial clustering of industrial activities, in a few pockets of a region, has been very significant aspect of modern industrial development. Such concentrations not only minimize the locational costs (Weber, 1909; Losch, 1940; Isard, 1956) in the beginning, but also mobilize the infrastructural bases, encourage efficiency and augur betterment at the regional level. The agglomeration and continuous em-bristling of industries, which are spread over a space with developed industrial infrastructures, may be identified as industrial clusters (Perroux, 1950; Boudeville, 1961; Klaassen, 1967). When clustering of manufacturing units is functionally as well as spatially interlinked to each other, they form an industrial complex (Hansen, 1972; Isard, 1960). The modern concept of industrial development has to be viewed not only from the production and employment perspective, but also from the larger perspective of social goals and spatial patterning of human activities in general (Mishra, 1971). Such integrated industrial development may be achieved with the setting up of a few nucleus plants preferably in the backward regions (Isard, 1960) to generate many ancillaries and small units nearby. More-

over, the nucleus plants ensure a widely spread pattern of the evolution of industrial landscape, the formation of industrial pattering and creation of industrial complexes and regions in the development of an industrialized economy of the country.

This study is primarily based on secondary data with a few primary data available during the survey of industries as field check. The secondary data are obtained from the census records and published reports available from the offices of Madhya Pradesh, Directorate of Industries as well as Directorate of Economics and Statistics, Bhopal.

THE STUDY AREA

Madhya Pradesh (18° - 26° N and $74^{\circ}15'$ - $84^{\circ}25'E$), a socially and economically backward state, lies in the central part of India. It has a vast and varied pattern of resources in forest, agriculture, mineral and power. The ranges of mountains and three river systems, viz., Ganga, Narmada and Mahanadi create the hydel power potential in the state. Tropical monsoonal climate reveals vast and varied forest resources. Many agricultural raw materials like cotton, sugarcane etc. and livestock products favour the agro-based industries. Three ther-

mal power plants, i.e., Korba, Amarkantak and Satpura and three hydel power houses namely Gandhi Sagar, Rana Pratap Sagar and Jawahar Sagar are generating excess electricity in the state. The state is served with three different railways - western, central and south-eastern-covering a total length of 5713 kms. alongwith the total metalled road length of 71648 Kms. in 1986. Thus, Madhya Pradesh predominantly an agrarian and rural state, has vast natural resources for the future industrial development.

DELIMITATION OF INDUSTRIAL CLUSTERS

The identification of industrial cluster is a difficult task. Pounds (1951), Buchanan (1951) and Jarrett (1977) have much discussed this difficulty. The concept of industrial location and concentration was initiated by Weber (1929) and then followed by other economists like Losch (1940), Hoover (1948), Greenhut (1956) and Isard (1956). They discussed the agglomeration economies which exerted a positive influence on the industrial clustering. Isard (1960) made a more comprehensive attempt to discuss the industrial complexes and also analysed it as a parameter of growth of the region. Klaassen (1967) has adopted his well known attraction theory-a theory of inter-industry relations -for the selection of bundles of industries. Peter (1972) made studies on industrial complex by means of geometric programming.

A few remarkable works have been done by geographers in the field of industrial complex. Britton (1961), Logan (1966), Karaska (1969), Richter (1970), Steed (1970) and Townroe (1970) attempted to identify the structure and functions of the complexes. They have stressed the role of linkage in the development of industrial complex. Luttrell (1972) adopted industrial complex as a factor of measurement for the growth of an economic

region. The Swedish school is dominated by Hagerstrand (1967), Warneryd (1968) and Tornqvist (1970). Taylor's (1969) seed-bed Growth Theory explains that the majority of small companies tends to locate in the vicinity of existing industrial concentrations.

Among recent contributors, the work of Barff (1987), Benton (1988), Willmore (1989) and Warner (1989) are remarkable which are focused on the clustering trend of industries in different areas. Richter (1988) demarcated 'Industrial Park' in the case of south-eastern Wisconsin. Auty (1990) has shown the impact of heavy industry clustering in the case of south Korea.

Regarding the delimitation of industrial clusters, several criteria have been adopted by many scholars. De Geer (1927) considered 'number of employed persons' as a criteria. Hartshorne (1936) delimited manufacturing concentration with the help of 'percentage of persons employed in manufacturing to the total employment'. Strong (1937) used 'power consumption' and Wright (1938) adopted 'the value added by manufacturing'. Florence (1948) adopted location quotient as an index to show the degree of industrial concentration. Jone (1938), Thompson (1955), Miller (1962) and Alexander (1977) have used multiple criteria to delimit the manufacturing concentration like, number of establishments, employees, production workers etc.

A few Indian scholars have also worked in this field. Majid (1949) has focused on the industrialization of Bihar. The work of Karan and Jenkins (1959) and Karan (1964) are based on employment statistics in the case of India. Mukherjee (1970) pointed out the industrial complexes of Chhotanagpur on the basis of material and product linkages. Ghose and Chakravorty (1971), Chaudhuri (1971, 1972, 1973); Sinha (1972) and Dayal (1975) have worked on delimitation of industrial concen-

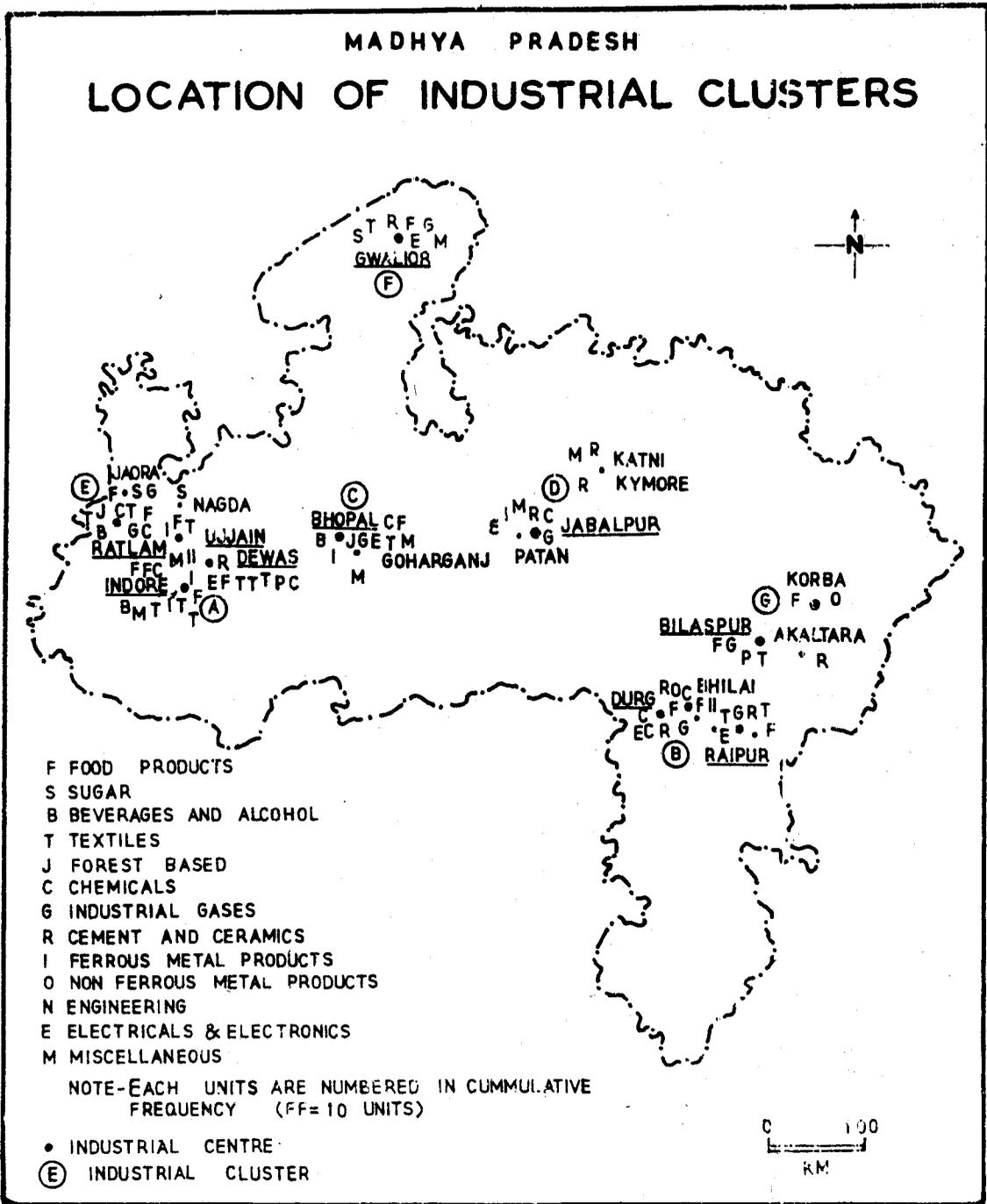


FIG.1

tration. Mahmood (1977) adopted location quotient as index to show the degree of industrial concentration. Sharma (1980, 1984) analysed the industrial location of Chhattisgarh region. Sharma (1987) has identified industrial concentration in Madhya Pradesh on the basis of industrial units and employment.

In this study, industrial intensity has been calculated to delimit the industrial clusters as follows :

Industrial intensity = $(X+Y)/2$ where 'X' is percentage value of industrial units in a district to total units of Madhya Pradesh, and 'Y' is percentage value of industrial employment to the total industrial employment of Madhya Pradesh.

It is observed that Durg district stands with the highest index (17.24) followed by Dewas (10.61), Indore (10.19), Bhopal (7.84), Ujjain (7.44) and Jabalpur (5.16). Bilaspur, Gwalior, Raipur and Ratlam districts have the intensity between 3.00 to 5.00, while 10 districts have the intensity between 3.00 to 5.00, while 10 districts have very low intensity lying between 1.00 to 3.00. The remaining districts have less than 1.00 as intensity. On the basis of this analysis, the clustering of industrial activities has been identified into those districts whose index value are 3.00 and above. Thus, 10 districts are identified as having high concentration of industrial activities which form seven industrial clusters namely, Indore-Dewas-Ujjain, Durg-Raipur, Bhopal, Jabalpur, Ratlam, Gwalior and Bilaspur-Korba industrial clusters (Fig. 1 and 3).

SPATIO-TEMPORAL EVOLUTION OF INDUSTRIAL CLUSTERS

Modern industrialization was started in Madhya Pradesh after reorganization of the state in 1956. Before reorganization, a few industrial centres were prominent such as, Gwalior, Indore, Ujjain, Ratlam, Jabalpur and Bhopal produc-

ing mainly consumer goods like food products, textiles, cement and ceramics and sugar etc. The initiation of modern industrialization started with the establishment of National News Print Mill at Neapanagar (Khandwa), Bharat Heavy Electricals Ltd. at Korba (Bilaspur) and Currency printing press at Dewas. These units gave impetus to a new phase of industrialization for further strengthening and dispersal of industries which led to the formation of industrial centres as well as emerging of industrial clusters (Fig. 2). With the beginning of Fifth Five Year Plan, the industrial decentralization and diversification started within the industrial clusters and geographical expansion took place in industrial centres due to availability of industrial infrastructures, capital, subsidies, loans, other facilities etc. Industrial diversification took place due to geographical expansion and spatial linkages (vertical, horizontal, diagonal and technological) with industrial clusters. Thus, with the beginning of Eighth Five Year Plan, seven industrial clusters, viz. Indore - Dewas - Ujjain, Durg-Raipur, Bhopal, Jabalpur, Ratlam, Gwalior and Bilaspur - Korba have emerged in the state (Fig. 1 and 3).

REGIONAL STRUCTURE OF INDUSTRIAL CLUSTERS

The identification and spatial industrial structure of the clusters have been analysed in detail (Table 1 and 2) as follows :

(A) INDORE - DEWAS - UJJAIN INDUSTRIAL CLUSTER

It is the largest and most significant industrial agglomeration which lies in the districts of Indore, Dewas and Ujjain. It accounts for 30.60 per cent of the total industrial units and about 26 per cent of the total employment of major/medium industries and only 8.27 per cent of total units and 11.06 per cent of total employment in small scale sector.

Table 1.

Structure of Industrial Cluster I (Percentage of major/medium industrial units)

Industrial groups	Industrial clusters							
	Indore Dewas	Durg Raipur	Bhopal	Jabalpur	Ratlam	Gwalior	Bilas- pur-Korba	Total
Food Products	5.36	2.22	0.95	-	0.96	0.63	0.63	10.75
Sugar	0.63	-	-	-	0.32	0.31	-	1.26
Beverage & Alcohol	0.63	-	0.31	-	0.31	-	-	1.25
Textiles	10.09	0.31	0.31	-	0.31	0.96	0.32	12.30
Forest based	-	0.31	-	-	-	-	-	0.31
Chemical	2.52	0.96	0.63	0.31	0.63	-	-	5.05
Industrial gases	-	0.63	0.63	0.31	0.63	0.31	0.31	2.82
Cement and Ceramics	0.63	1.26	-	1.89	-	0.31	0.63	4.72
Ferrous metal- based	5.67	3.48	0.31	0.31	0.63	-	0.32	10.72
Non-Ferrous metal- based	0.63	-	0.31	-	-	-	0.31	1.25
Electricals & Electronics	0.96	0.31	0.96	0.96	-	0.32	-	3.51
Engineering	-	0.63	-	-	-	0.31	-	0.94
Paper	0.32	-	0.31	-	0.31	-	0.63	1.57
Miscellaneous	3.15	0.63	0.96	1.26	0.63	0.63	0.32	7.58
Total	30.59	10.73	5.68	5.05	4.73	3.78	3.47	64.03

Source: Based on Statistics of Directorate of Industries, M.P. 1986.

Table 2.

 Structure of Industrial Clusters II
 (Percentage of industrial units, capital investment and employment)

Industrial clusters	Industrial MMI	units SSI	Capital MMI	Investment SSI	Employment MMI SSI
(A) Indore-Dewas- Ujjain	30.59	8.27	13.18	14.33	25.88 11.06
(B) Durg-Raipur	10.73	10.63	46.71	13.43	31.00 10.73
(C) Bhopal	5.68	1.88	5.02	4.25	10.00 2.71
(D) Jabalpur	5.05	2.65	0.89	4.81	5.26 4.80
(E) Ratlam	4.73	1.70	0.82	4.15	3.37 2.07
(F) Gwalior	3.78	2.71	0.92	6.29	4.58 3.56
(G) Bilaspur-Korba	3.47	5.12	15.04	3.18	3.85 5.62
Total	64.03	32.96	82.58	50.44	83.94 40.55

Source: Based on Statistics of Directorate of Industries, Bhopal, 1986.

With the establishment of Currency Printing Press at Dewas, the industrial infrastructures have generated the establishment of a variety of industries in Dewas with the feeling of security and entrepreneurship benefits. Metallic industries, textiles, food-stuff and chemical industries are located at Dewas and Sonkutch centres. Textile, food-processing and metallic industries are prominent in Indore, Mangalia and Barlai. Mahidpur and Nagda in Ujjain are other industrial centres. Other industries i.e., cement and ceramics, electricals and electronics, Paper, Sugar, beverage etc. are also located in this cluster. This clustering is mainly due to facility of infrastructures specially, power (from Gandhi Sagar Project), good transport network (both rail and road-lying on Delhi-Bombay trunk route) and nearby location of state capital Bhopal. However, this cluster is facing some problems related with the adequacy of mobility of goods and skilled labour, technological know how, good management and environmental hazards.

(B) DURG-RAIPUR INDUSTRIAL CLUSTER

This cluster is located in the districts of Durg and Raipur. It registers about 11.00 per cent of total factories and 31.00 percent of total employment of major/medium industries. Also, about 11.00 per cent of total units and 11.00 per cent of total employment of small scale sector have been registered. The largest unit, 'Bhilai Steel Plant', which was the first and most prerogative establishment and employed maximum workers (25.00 per cent of total workers) is located in this cluster. Industries are centralized along the axis of Raipur- Kumhari - Bhilai-Durg-Rajnandgaon Fig. 3). The metallic industries account for 26.83 per cent of total units and 90.00 per cent of total workers. Industrial gases, cement and ceramics, food - processing units, electricals, chemical textile and forest-based industries are also

significant. The availability of mineral like, iron-ore, deposit of Dalli-Rajhara, limestone and dolomite from nandini and nearby fields of mangness (Balaghat), transport facility, power (from Korba and Bhilai), Capital and technological collaboration (from Rassia) and labour availability from surroundings are significant factors for the localization of Bhilai steel plant and other industries. However, the BSP is itself a factor for the location of other industries and development of small industrial centres.

(C) BHOPAL INDUSTRIAL CLUSTER

Bhopal, with the establishment of BHEL and allied industries, emerged not only as a major industrial centre, but, further coming up a large number of industries in the surrounding small centres, formed a cluster. Bhopal shares 6.00 per cent of total industrial units and 10.00 per cent of employment of major/medium sector. About 2.00 per cent of total industries and 3.00 per cent of employment occur in the small scale sector. The BHEL alone employs 8.00 per cent of total workers. It manufactures steam turbines and generators, motors and rectifiers, hydro-turbines, transformers, switch gears and capacitors etc. which are not only supplied for national use, but also exported outside the country. Other big unit is Union Carbide which appeared as an chemical industry employing 800 workers but now closed due to gas leakage hazard. Many other industrial units of food-stuff, beer, textiles, gases, steel, forgings, copper and alloys, batteries, straw boards, glass fibers and valves etc., are centralized in the Bhopal Industrial Estate. Now, a few small centres like, Pipalani, Barasia etc. are coming up with the location of major/medium units. Bhopal, being capital of the state, is itself a dominant factor to develop industries in this cluster. The entrepreneurs feel a surity of the availability of many prominent infra-

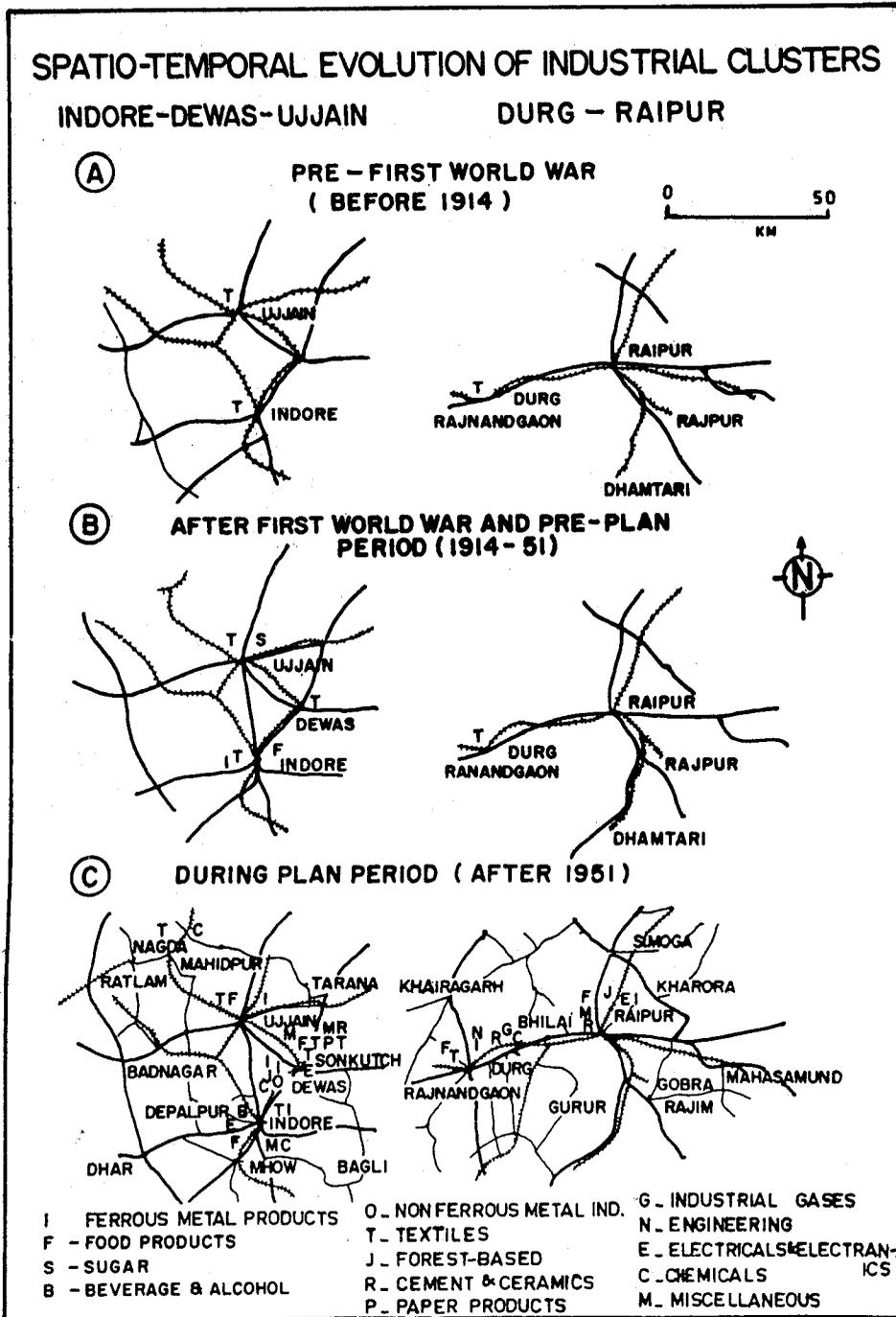


FIG. 2

structures like, power, capital, technology, skilled labour, market and raw materials etc. Bhopal is linked with road, rail and air transport not only from the interiors of the state, but

has the facility of interstate relations also. The location of Satpura Power station is another facility for the supply of electricity. Recently, the chemical industries have to face the

environmental pollution problem which created major health-hazard in the surroundings.

(D) JABALPUR INDUSTRIAL CLUSTER

This cluster includes the centres like Katni, Kaimore, Patan, Panagar, Khamaria etc. With location and development of many industries and inter-linkages during the Sixth Five year Plan. Jabalpur came up as a cluster in the central part of the state. It accounts for 5.00 per cent of total industrial units and 5.00 per cent of employment in major/medium sector. The share of small scale sector is 3.00 per cent of total units and 5.00 per cent of employment (Table -2). Jabalpur has been a centre of defence-equipments and heavy vehicle manufacturing for a long period. Four defence factories are in existence under Central Public Sector which produce ammunition components, defence and heavy commercial vehicles. Besides defence factories, cement and ceramic industries, metallic industries, electrical and electronics, engineering, industrial gases, chemicals and allied industries are also established in this cluster. Jabalpur industrial cluster is facilitated with the Allahabad-Bombay railways and Allahabad-Nagpur national highways, power from Amarkantak and Satpura Thermal Power stations and many raw materials like, limestone, manganese, hematite, bauxite etc. from its surroundings. However, this cluster is facing the problems of capital, technology - transfer, replacement of old machines, skilled labour, management and the government policies too.

(E) RATLAM INDUSTRIAL CLUSTER

This industrial cluster is located in the western part of the state in Ratlam district. It registers 4.73 per cent of industrial units and 3.37 per cent of employment in major/medium sector, while only 1.70 percent of

factories and 9.07 percent of employment in small scale sector. Shri Sajjan Mills Ratlam, Jaora Sugar Mills Ltd. and Digvijaya Industries Ltd. Bangrod are big industries which attract other industries to locate their in surroundings. Industries are located mainly at Ratlam, Jaora and Bangrod which produce cotton and yarn cloth, sugar, MS bar rods, steel ingots, rolling mills, straw boards, spirit, alcohol and other chemicals, vegetable oil, kerosene oil and acetylene etc. This industrial cluster benefits from the nearby the location of Indore-Dewas-Ujjain industrial cluster which provides many infrastructural and locational inputs directly as well as indirectly. Availability of transportation (Baroda-Ujjain railways and other linked roads), labour (from western population agglomeration), power (Satpura Power Station) and some raw materials inspired the growth of industries in this cluster. It seems that the linkage of neighbouring cluster will be extended to this cluster, and then both will be one industrial region. Localizing in the northern part of the state in the Gwalior district, this cluster accounts for 4.0 per cent of industrial units and 5.00 per cent of workers of major/medium industries. Three percent of industrial units and 4.00 per cent of employment in small scale sector are marked in this industrial cluster. Textile factories at Biral Nagar and Sugar Factory at Debra were the nucleus plants but, now diversification took place and, besides textile and sugar industries, a variety of industries, viz. electrical and machine tools, food processing, cement and ceramic products engineering industries are established in this cluster. Many agro and forest based small scale industries are also established during the pre-independence period. The policies of Maharaja Madhava Rao Sindhia had played a significant role in industrial development of this cluster. Later on, the development has occurred with the coming up of Satpura Power Station. Gwalior

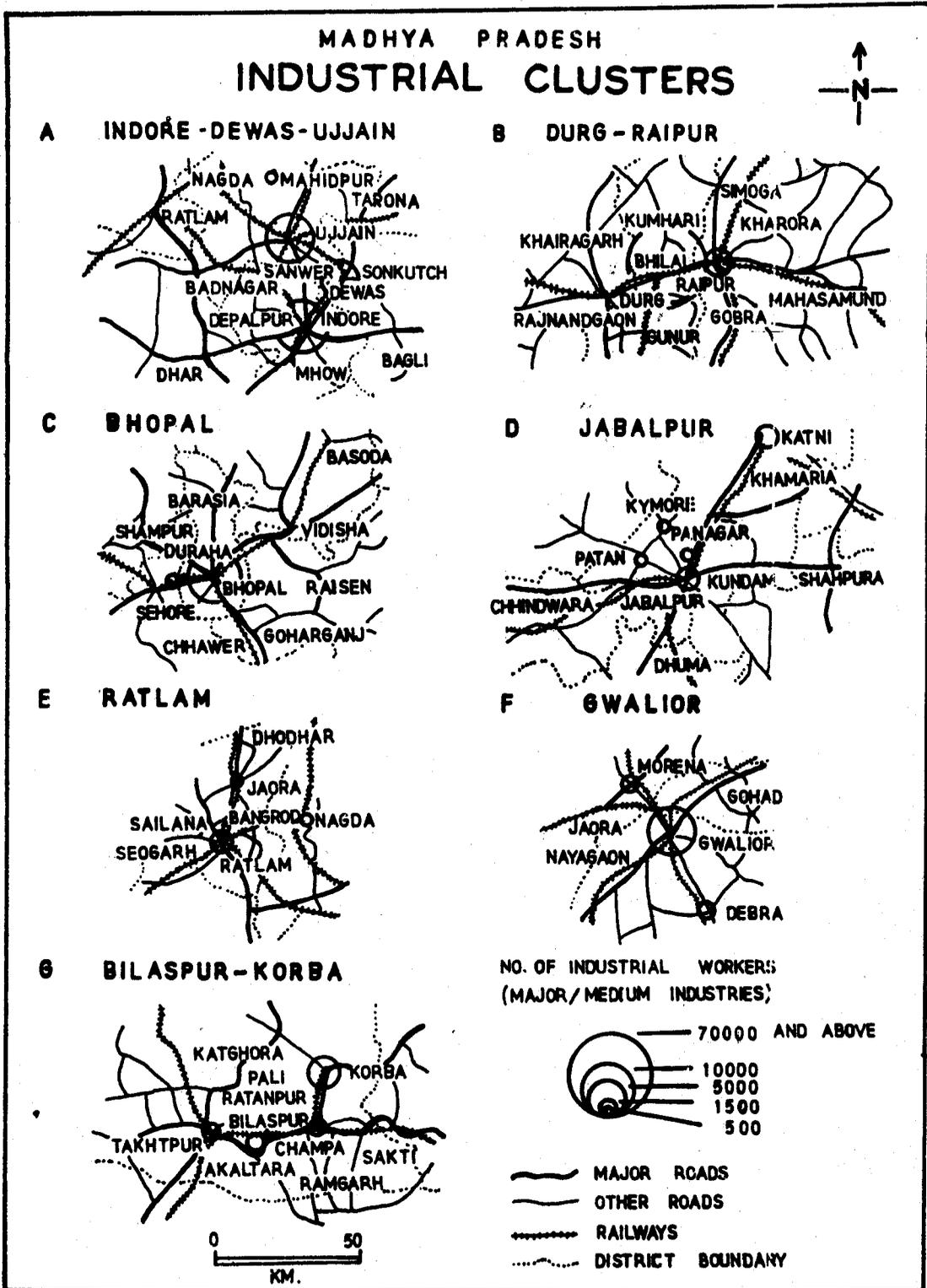


FIG. 3

is linked with the national and state highways as well as Delhi-Madras trunk railways. Iron-ore, dolomite etc. are found in the Gwalior and neighbouring areas. Thus, the historical development supported by the resource availability and infrastructural development, Gwalior emerged as an industrial cluster.

BILASPUR - KORBA INDUSTRIAL CLUSTER

This cluster is situated in the eastern Madhya Pradesh to the north of the Raipur - Durg industrial cluster. It enjoys 3.50 per cent of total units and 4.00 per cent of employment of major/medium sector. However, 5.00 per cent of total units and 6.00 per cent of employment have been shared by the small scale sector. Korba Aluminium Plant plays a significant role in the clustering. Paper, textile, industrial gases, cement and ceramic products are prominent which are located at Korba, Bilaspur, Akaltara and Champa Centres. Many other industries, viz., food processing, metallic and other miscellaneous industries are concentrated in this cluster. This cluster is linked by the Hawrah-Bombay railway route. Korba coal fields provide coal and Korba Thermal Power Plant provides electric power to this cluster. Amarkantak and Phutakapahar deposit supply bauxite to the Aluminium Plant. A few important minerals like, limestone, dolomite, clay, manganese etc. are produced in neighbouring areas. Availabil-

ity of entrepreneurs, marketing facility, labour and agricultural raw materials are other factors which allowed the development of this cluster.

CONCLUSION

An overview of the above analysis reveals that these industrial clusters have initiated the decentralized distributional pattern of industries in the state. Totally 64.00 per cent of industrial units in major/medium sector and 33.00 per cent of small scale sector have been occupied by the seven industrial clusters lying in ten districts of the state. It means more than half of major/medium industries and one third of small scale industries are agglomerated in one fifth of the district. The small industries are relatively more decentralized. Thus, there are two significant areas of industrial clustering which may amalgamate in future as industrial regions, viz., one in western part (Ratlam - Indore - Bhopal - Ujjain - Dewas) and another in eastern part (Durg - Raipur - Bilaspur - Korba) of the state.

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